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Title: "Ranking Optimization of Internet Search Engines: An Analysis from the Publisher's Perspective"

Ranking Optimization of Internet Search Engines:

An Analysis from the Publisher's Perspective

Abstract

Search engine optimization is an extremely important research area that has rarely been addressed in a systematic, controlled way. While many commercial Internet "consultants" offer vague advice about how to optimize Web page ranking, scholarly research does not exist on this topic. Web publishers continue to have difficulty in finding a good strategy for optimizing their Web pages. This research will identify factors that impact search engine optimization, analyze their impacts on the major search engines on the Internet, and then recommend applicable and practical methods for improving search engine optimization. The findings of this research will benefit Web publishers, search engine designers and Web information seekers.

The findings of this research will enable libraries and museums, particularly those involved in digital library activities, to better place their Web sites in end user searchers' result lists. The findings will help these institutions to optimally disseminate their information products to more Internet searchers who use all-purpose search engines for their information retrieval tasks. This will enhance the accessibility to the information these organizations provide to the information seeking public.

The primary activities of this project include 1) identifying variables that represent the search elements in various parts of a published Web site, 2) creating a series of Web sites with identical content but different variables, 3) publishing these sites on the Internet, 4) collecting data on the placement of these sites in the result lists using ten search engines, and 5) analyzing the data and preparing and disseminating the results.

Ranking Optimization of
Internet Search Engines: An Analysis
From the Publisher's Perspective

Introduction and Impact

The world of the Internet was incredibly transformed with the development in the mid-1990s of search engines. These tools provided access to the overwhelming number of resources on the Web to not only academic users, but increasingly to the general public and commercial enterprises. Not surprisingly, information science researchers as well as a growing group of information entrepreneurs began evaluating the performance of various search engines. Reviews of the literature about search engine performance focus on one viewpoint: that of the user. (Lowley 2000; Schwartz 1998; and Leighton & Srivastava 1997) This addresses the needs of only half of the Internet user community.

Generally speaking, Internet users can be categorized into two broad groups: end user searchers and Web page publishers. The first group's priority is to locate information on the Internet conveniently and accurately. Most of the time, these users prefer to employ a search engine to do the job. The second group's priority is to maximize the probability that their published Web sites get indexed by search engines and ranked high on searchers' search engine result lists. With the creation of digital libraries in all sorts of environments – libraries, non-profit organizations, museums, to name a few – insuring that the end user searchers find a particular Web site is becoming increasingly difficult. Information organizations – those institutions that have traditionally provided the organizational and access tools for information seekers – are now dealing with an increasingly complex digital world. While providing a discrete address to a collection of digitized information mimics traditional access to collections, the distributed nature of information retrieval requires that information institutions consider additional means of providing access to their resources.

One option would be to structure the content of a Web site (e.g., a digital library's front page) so that general search engine searches will be likely to find it. Current conventional wisdom (http://searchenginewatch.com/webmasters/rank.html) and the limited research on retrieval success (Schwartz, 1998) offer hints at what might be more effective. For instance, if getting a Web site to appear at the beginning of a result list is the goal, it is not enough to simply add META tags and to submit the site to an enormous number of search engine indexes and directories. There are many factors that affect the ranking within search engine result lists. For example, search algorithms, automatic indexing algorithms of the search engines, and the way publishers construct and post their Web pages.

Search engine optimization has become a very complex, sophisticated practice that requires constant research, practice, and reevaluation to be effective. A growing industry has blossomed that offers advice (for a fee in most cases) on maximizing Web page placement (for example, http://www.aaxis.com; http://www.bruceclay.com; http://www.goldranking.com; http://www.inc.com; www.http://www.searchengineadvice.com; http://www.searchengineposition.com; and http://www.1stsearchranking.com). This advice about which techniques will provide

optimal ranking results is hinted at on the Internet itself but none of those offering advice provide the details on which their recommendations are based. While a common theme among these advice-givers is "location, location, location" the specific advice is fairly generic and based on conventional wisdom, not tested hypotheses. This research will remedy that situation by focusing on exactly how Web page construction and posting effect ranking on result lists of various search engines.

This study will examine various Web design factors and their relationship to search engine result list placement. The overarching research question is: "How can the ranking of a Web site in a search engine's result list be improved?"

Adaptability

The issue examined in this research is a universal one insofar as the use of the Internet could potentially be used by anyone. The issue of site ranking within a result list is most obviously of interest to Web site publishers. Current "literature" (mostly prepared by commercial firms offering consulting services) focuses on the benefits to the private sector of high site ranking. However, this issue would be of equal interest to those in the non-profit sector, including libraries and museums, because of their inherent interest in disseminating information about their own institutions as well as increasing access to their various information seeking constituencies.

The results of this research will be disseminated through a number of scholarly and professional media. The findings will enable libraries and museums, particularly those involved in digital library activities, to better place their Web sites in end user searchers' result lists. The findings will help these institutions to disseminate their information products to more general searchers who use all-purpose search engines for their Internet searching.

Design

This study will involve creating a Web site template, duplicating its content in a series of Web sites that differ only in the descriptive data in the site areas identified as independent variables, publishing the Web sites, and then periodically testing ten search engines' success at retrieving the different versions of Web site. The retrieval activity will be repeated over three months.

Objectives. The objectives of this research are threefold: 1) to identify Web site design factors that impact ranking in search engine result lists, 2) to compare the impact of those design factors on different general search engines, and 3) to develop a practical strategy (approach) to improve ranking of a Web page from an Internet search engine. The significance of this research is that the findings will help Web publishers increase traffic to their Website by testing Web page design features that will optimize ranking in search engine result lists.

Variables. The primary independent variables in this study are keywords and their status in a published Web page. The dependent variable is the ranking position in a search engine result list.

The independent variables may include, but are not limited to:

a. Title metadata tag
b. Web page title
c. Head, subhead metadata tag
d. Frequency of occurrence in different variables (title, head, full text,)
e. Descriptor metadata tag
f. Subject metadata tag
g. Full text
h. Timing
i. Combinations of the above variables
j. Other factors like position and order of keywords, font size, font color, and different forms of a keyword (e.g., “ing”, “ed”, plurals, variant spelling).

The study will examine keyword frequency on ranking performance. Web pages within the same category but different keyword frequencies will be treated separately. For instance, Web pages with keyword frequencies of 1, 2, 3… in the subject category will correspond to different Web sites.

The impact of the variable combinations on ranking performance will also be examined. The study will answer questions like whether Web pages with keywords in the title and the subject categories achieve better ranking performance than those with keywords in keyword and heading categories. While Title, Creator, Subject, Description, Publisher, Contributor, Date, Type, Format, Identifier, Source, Language, Relation, Coverage, and Rights are all metadata elements, Title, Subject, and Description are singled out for examination in this study.

The search engines used in this study will be those that have been identified as the most frequently used by general search engine users (see *Methods* section). The ranking position refers to the position of a specified Web page in a result list of a search engine after a query is submitted to that search engine.

Methods. This study will be accomplished in eight discrete steps, described below.

Step 1: Select the Internet search engines. According to one Internet entrepreneur “about 95%” of Internet traffic is generated by 8 major search engines (http://www.hot-new.com/webrank.htm#dyn). Given the proprietary nature of the services offered by this entrepreneur, no explanation is given as to how this figure was determined. This is indicative of the lack of reliable research that documents Internet search engine use. However, reports exist that have identified highly used general search engines (Sullivan, 2000). The selection of the search engines will be based on coverage, use frequencies, and any available evaluation studies. At this time, the following search engines are among the most highly ranked in terms of frequency of use (listed in alphabetical order): Altavista, Ask, Dogpile, Excite, Go, Google, iWon, Looksmart, Lycos, MSN, NBCi (Snap), Netscape, NorthernLight, Yahoo (Sullivan, 2000). An updated literature and Web search will be undertaken immediately prior to the project’s start to determine if any changes need to be made to this list.

Step 2: Select a subject domain that will provide the content of the Web page and determine keyword(s) for the full text that will be used in title field, heading field, title

of Web page, title of the full text. The content of the selected full text should not be too specific nor too general. A reasonable content for the full text of the Web site will assure a reasonable selection of keywords for the query. An excellent candidate for content is consumer health information. This area provides a good variety of terms and is an extremely popular search topic among Internet searchers. It is estimated that 17.5 million adults in the United States, or 43% of the 40.6 million who use the Internet, are searching for health information on more than 15,000 health related Web sites (Miller et al, 2000).

Site content related to a consumer health topic (for example, treatment options for migraine headaches, including traditional and complementary medicine) will be developed. Content will be carefully selected and evaluated following guidelines published by the Consumer and Patient Health Information Section of the Medical Library Association (CAPHIS, 2001).

Step 3: Produce several test Web sites with the same content but incorporating the different design features. That is, each Web site will have the identified key words in a different location (see independent variables) and/or in multiple locations:

(W1): A Web site with the selected keywords in title;
(W2): A Web site with the selected keywords in heading;
(W3): A Web site with the selected keywords in Web title;
(W4): A Web site with the selected keywords in subject tags;
(W5): A Web site with the selected keywords in keywords tags;
etc.

Step 4: After the various versions of the Web page are created they will be published on the Internet with different addresses. We will record the time when these Web sites are published on the Internet.

Step 5: We will formulate a standard query that will be formulated in such a way that it should retrieve information on the specific topic of our web site content. The search query will be standardized but minor modifications may need to be made to insure search consistency across the various search engines' default search protocols. Keywords used in the standard query will be extracted from Web site's full text. This standard search query will be used to search the Internet for our Web sites. It will be input in the 10 selected search engines. The position of our Web sites within the result list will be recorded. This search and record step will be repeated weekly for twelve weeks.

Step 6: Raw data will be tabulated in the following way:

Table for variable *i*:

Time period *Search Engines*	Week 1	….	Week 8
Search engine 1	N (rank on result list)		
. . .			
Search engine 10			

The number of defined tables will be determined by the total number variables defined in step 3. That is, each Web page designed in Step 3 will correspond to a raw data table. The time interval will be one week. In other words, every week we will search all the search engines using the same search strategy.

Step 7. Data analysis will be based on the raw data collected and organized in the tables described above. An *ANOVA* statistical approach will be employed to examine the performance across the defined multiple variables in the same category. For instance, which search engine achieves better ranking performance when keywords just appear in titles.

If necessary, a two-way *ANOVA* approach will used to test interaction of two variables on the ranking performance. For example, the interaction impact of frequency and combination on the ranking performance can be analyzed via the two-way *AVONA.*

A *T-test* will be used to test possible ranking performance difference between two variables. For example, ranking performance with keyword in subject tags is better than the ranking performance with keywords in keyword tags.

Final analysis will include comparisons such as:

A. There is no difference in a Web sites result ranking with metadata and without metadata;
B. There is no difference in Web site result ranking across different search engines;
C. There is no difference in Web site result ranking as a result of different keyword frequencies within the different categories (variables);
D. There is no difference in Web site result ranking between automatic indexing-based search engines and human-indexing-based search engine(s);
E. There is no difference in Web site result ranking between sites with various pairs of defined variables (keyword, heading, full text, Web title, subject);
F. There is no difference in Web site result ranking between sites with different variable combinations.

Hypotheses C and E will result in numerous comparisons as a result of the several variables that will be tested.

Step 7: Dissemination of results is discussed below in a separate section.

Management Plan

Administrative procedures related to accounting mechanisms, disbursement of monies, and compliance with University personnel policies will be handled by the School of Information Studies administrative staff. They have extensive experience in this area and are familiar with both University and federal government regulations.

Oversight of the project will be handled by Alexandra Dimitroff. Dr. Dimitroff has over ten years experience conducting sponsored research and is familiar with the policies governing such activities. The seven discrete steps in the project are as follows:

Step 1: Literature review and selection of search engines	Month 1
Step 2: Selection of subject domain, final determination of variables, and creation of content	Months 2-3
Step 3: Production and testing of Web sites	Months 4-5
Step 4: Publication on Internet	Month 6
Step 5: Formulation of search query	Month 7
Step 6: Data collection	Months 7-9
Step 7: Data analysis	Months 9-11
Step 8: Dissemination of findings	Month 11-12

Major responsibility for each step is as follows:

	Step1	**Step2**	**Step3**	**Step4**	**Step5**	**Step6**	**Step7**	**Step8**
Dimitroff	√	√			√	√	√	√
Zhang		√	√	√	√	√	√	√

Budget

The largest part of the budget is for personnel. The staff time to be devoted to the activities described above is based on the past experiences of the investigators. Details regarding allocation of personnel time and other expenses are provided in the budget notes. All salary figures are derived following University of Wisconsin-Milwaukee policy and procedures.

Contributions

The University of Wisconsin-Milwaukee will contribute a computer, printer, office space for the student assistant, travel funds, partial salary support for one investigator and summer wages for the student assistant. These contributions represent 35% of the project budget.

Personnel

Abbreviated curriculum vitae for the co-investigators are appended to this proposal. The two investigators are colleagues at the University of Wisconsin-Milwaukee School of Information Studies and bring complementary knowledge and skills to the project. They are both experienced information retrieval and evaluation researchers.

Dr. Zhang has been actively involved in information retrieval research since 1985. His research interests and expertise focus on information retrieval theory, retrieval algorithm analysis, visualization for information retrieval, digital libraries, and Internet search engine analysis. He has won the "International Paper Contest on Digital Library or Information Science and Technology in Developing Countries" award (2000) and the "Pratt-Severn Best Student Research Paper" award, sponsored by the American Society for Information Science (1995). His software application DARE system won the "1999 Information Engineering Award" at the University of Pittsburgh. He has published more than 50 research papers and Dr. Zhang's work on distance-angle-based and angle-angle-based information retrieval visualization models has appeared in the most reputable peer reviewed journals in library and information science.

Dr. Dimitroff has over ten years experience in information retrieval system design and evaluation. Her original work in user mental models developed into several investigations of user success using searching Boolean-based and hypertext-based interfaces. Dr. Dimitroff brings experience with a variety of investigational methods to this project. Her success as a researcher was recently confirmed by her ranking as the 9th most published LIS researcher in North America. In addition, Dr. Dimitroff's experience as a health sciences librarian and her continued work within that domain will insure that appropriate quality content is used in preparing the project's web sites.

A master's level student assistant will be hired to help with content development, testing of the Web sites, query development, and data collection.

Project Evaluation

As an experiment, evaluation methods are not suitable for this project. The use of rigorous statistical measures, however, insure that the findings will be generalizable and of a quality that does not currently exist in the literature of Web site evaluation. Specifically, this will involve use of *ANOVA* to examine the performance across the defined multiple variables in the same category and, if appropriate, use of two-way *ANOVA* to test interaction of two variables on the ranking performance as well as a *T-test* to test possible ranking performance difference between two variables.

Dissemination

Dissemination of the findings of this study will be threefold: 1) a technical report to be published by the UWM School of Information Studies; 2) presentation at appropriate scholarly and professional conferences; and 3) publication in respected scholarly and professional journals. The two investigators have strong track records in publishing in the LIS literature.

Conclusion

Search engine optimization is an extremely important research area that has been addressed only by Internet "consultants." These consultants' advice is relatively vague and completely devoid of validating information. Scholarly papers, describing rigorous testing techniques, do not exist on this topic. And despite the existence of these many advice givers, Web publishers, as one of the major Internet user groups, have difficulty in finding a good strategy for optimizing their Web pages. This research will identify factors that impact search engine optimization, analyze their impacts on the major search engines on the Internet, and then recommend applicable and practical methods for improving search engine optimization. The findings of this research will benefit Web publishers, search engine designers and Web information seekers.

References

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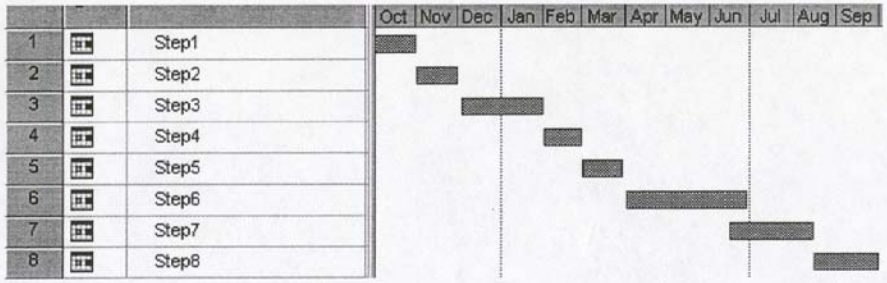
Schedule of Completion

The proposed project will be completed in one year: October 1, 2001 - September 30, 2002. Project activities are as follows:

Activity	Dates	Expenditures
Step 1: Literature review and selection of search engines	October 2001	$ 6,000
Step 2: Selection of subject domain, final determination of variables, and creation of content	November 2001	$ 2,900
Step 3: Production and testing of web sites	December 2001-January 2002	$ 2,000
Step 5: Formulation of search query	March 2002	$ 2,000
Step 6: Data collection	April-June 2002	$18,959
Step 7: Data analysis	June-August 2002	$ 9,091
Step 8: Dissemination of results	August-September 2002	$ 2,100
	Total:	$50,340



Project Budget Form

SECTION 1: DETAILED BUDGET

Year 1 – Budget Period from 10 / 01 / 01 **to** 09 / 30 / 02

Name of Applicant Organization Board of Regents of the Univ. of Wisconsin System, UW-Milwaukee

IMPORTANT! READ INSTRUCTIONS ON PAGES 2.3–2.4 BEFORE PROCEEDING.

SALARIES AND WAGES (PERMANENT STAFF)

NAME/TITLE	NO.	METHOD OF COST COMPUTATION	IMLS	APPLICANT	PARTNER(S) (IF APPLICABLE)	TOTAL
Dimitroff, A	(1)	1/9 academic year				
Dimitroff, A	(1)	one month summer				
Zhang, J	(1)	1/9 academic year				
Zhang, J	(1)	one month summer				
		TOTAL SALARIES AND WAGES $	17,977	6,810		24,787

SALARIES AND WAGES (TEMPORARY STAFF HIRED FOR PROJECT)

NAME/TITLE	NO.	METHOD OF COST COMPUTATION	IMLS	APPLICANT (IF APPLICABLE)	PARTNER(S)	TOTAL
student assistant	(1)					
	( )					
	( )					
	( )					
		TOTAL SALARIES AND WAGES $	6,750	2,250		9,000

FRINGE BENEFITS

RATE	SALARY BASE	IMLS	APPLICANT	PARTNER(S)	TOTAL

CONSULTANT FEES

NAME/TYPE OF CONSULTANT	RATE OF COMPENSATION (DAILY OR HOURLY)	NO. OF DAYS (OR HOURS) ON PROJECT	IMLS	APPLICANT	PARTNER(S) (IF APPLICABLE)	TOTAL
		TOTAL CONSULTANT FEES $				

TRAVEL

FROM/TO	NUMBER OF: PERSONS	DAYS	SUBSISTENCE COSTS	TRANSPORTATION COSTS	IMLS	APPLICANT	PARTNER(S) (IF APPLICABLE)	TOTAL
professional mt	(1)	(3)	600	400	1,000			1,000
research mtg	(2)	(3)	1,200	600	540	1460		2,000
IMLS directed	(2)	(3)	1,400	600	2,000			2,000
travel	( )	( )						
			TOTAL TRAVEL COSTS $		3080	1920		5,000

Project Budget Form

SECTION 1: DETAILED BUDGET CONTINUED

Year 1

MATERIALS, SUPPLIES AND EQUIPMENT

ITEM	METHOD OF COST COMPUTATION	IMLS	APPLICANT	PARTNER(S) (IF APPLICABLE)	TOTAL
computer workstation			6,000		6,000
printing, copying, suppli		1,250			1,250
statistical software, man		250			250
TOTAL COST OF MATERIALS, SUPPLIES, & EQUIPMENT $		1,500	6,000		7,500

SERVICES

ITEM	METHOD OF COST COMPUTATION	IMLS	APPLICANT	PARTNER(S) (IF APPLICABLE)	TOTAL
TOTAL SERVICES COSTS $					

OTHER

ITEM	METHOD OF COST COMPUTATION	IMLS	APPLICANT	PARTNER(S) (IF APPLICABLE)	TOTAL
TOTAL OTHER COSTS $					
TOTAL DIRECT PROJECT COSTS $		35,498	19,317		54,815

INDIRECT COSTS

Select either item A or B and complete C. (See section on Indirect Costs, page 2.4.)

Applicant organization is using:

☐ A. an indirect cost rate which does not exceed 20% of modified total direct costs – may be listed only as cost sharing.

☑ B. an indirect cost rate negotiated with a Federal agency (*copy attached*) - may be requested from IMLS, based *only* on *modified* direct costs (as specified in the negotiated agreement) that are charged to IMLS; additional indirect costs based on the applicant's or partner's contributions may be listed only as cost sharing.

Dept. of Health & Human Services — Name of Federal Agency

Oct 21, 1997 (being renegot.) — Expiration Date of Agreement

C. Rate base(s)			Amount(s)		
[IMLS]46	%	of $ 36,418	= $	16,752	
[appl.]46	%	of $ 18,397	= $	8,463	
	%	of $	= $		

	IMLS	APPLICANT	PARTNER(S) IF APPLICABLE	TOTAL
TOTAL INDIRECT COSTS CHARGED TO $	16,752	8,463		25,215

Project Budget Form

SECTION 2: SUMMARY BUDGET

Name of Applicant Organization Board of Regents of the Univ. of Wisconsin System, UW-Milwaukee

IMPORTANT! READ INSTRUCTIONS ON PAGES 2.3–2.4 BEFORE PROCEEDING.

DIRECT COSTS	IMLS	Applicant	Partner(s) (if applicable)	Total
SALARIES & WAGES				33,787
FRINGE BENEFITS				8,528
CONSULTANT FEES				
TRAVEL	3,080	1,920		5,000
MATERIALS, SUPPLIES & EQUIPMENT	1,500	6,000		7,500
SERVICES				
OTHER				
TOTAL DIRECT COSTS	$ 35,498	$ 19,317	$	$ 54,815
INDIRECT COSTS*	$ 16,752	$ 8,463	$	$ 25,215

*If you do not have a current Federally negotiated rate, your indirect costs must appear in the Applicant or Partner columns only. If you have a current Federally negotiated rate, you may request indirect costs from IMLS only on the direct project costs requested from IMLS.

TOTAL PROJECT COSTS $ 80,030

AMOUNT OF CASH-MATCH $ 26,860 $

AMOUNT OF IN-KIND CONTRIBUTIONS (INSTITUTIONAL COST-SHARING), INCLUDING INDIRECT COSTS $ $

TOTAL AMOUNT OF MATCH (CASH & IN-KIND CONTRIBUTIONS) $ 27,780

AMOUNT REQUESTED FROM IMLS, INCLUDING INDIRECT COSTS $ 52,250

PERCENTAGE OF TOTAL PROJECT COSTS REQUESTED FROM IMLS 65 %
(MAY NOT EXCEED 80% IF REQUEST EXCEEDS $250,000 – RESEARCH PROJECTS EXCEPTED, SEE COST SHARING ON PAGE 1.7)

Have you received or requested funds for any of these project activities from another Federal agency?
(Please check one) ☐ Yes ☑ No

If yes, name of agency _____

Date of application _____ or award _____ Amount requested or received $ _____

Budget Notes

Permanent staff salaries are included for support of the two investigators: 1/9th support for Dimitroff and Zhang to devote time to the project during the Fall 2001 and Spring 2002 semesters, respectively. One-ninth time is requested for Zhang for Summer 2002 support with 1/9 Summer 2002 support for Dimitroff contributed. The concentration of effort in the late spring and summer corresponds to the data collection, analysis, and dissemination activities.

The student assistant will work 10 hours/week for the Fall 2001 semester (15 weeks), 20 hours/week doing data collection during the Spring 2002 semester (15 weeks), and 10 hours/week during the Summer 2002 semester (15 weeks), a total of 450 hours over the study period.

Travel expenses are for presentation of findings at 1 professional meeting and two scholarly meetings. The expenses of one trip are contributed.

The School of Information Studies will contribute a Pentium 4 workstation that will be dedicated to this project. Statistical software and manuals, printing, copying and computer supplies costs were computed based on experience in the SOIS.

Indirect costs are based on the University of Wisconsin's negotiated rate with the U.S. Department of Health and Human Services. The agreement is dated 10/27/97 and is currently being used while being re-negotiated. The current document is included as an attachment.